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Research on the Long-term Mechanism for Pre-service Teachers' ICT Literacy Education*

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***Abstract*—ICT literacy is the ability that pre-service teacher, both as student and future teacher, must possess. It plays an important role in the development of both current personal learning and future vocation, and is also a necessary prerequisite and key factor for realizing education modernization in China. Based on "The ICT Teaching Competency Standards for Pre-service Teachers", this paper explains the long-term development strategy and mechanism of pre-service teachers' ICT literacy from the perspectives of the definition of pre-service teachers' ICT literacy, and the existing problems and solutions, in order to provide basis for cultivating the ICT literacy of pre-service teachers.**

Keywords—pre-service teacher; ICT literacy; long-term mechanism

I. INTRODUCTION

With the breakthrough development of ICT (Information and Communication Technologies), the connotation and extension of ICT literacy have undergone dramatic changes. The traditional ICT literacy education is in urgent need of reform to meet the requirements of the development of the times and education. Pre-service teacher is the key to the development of national education and the main force for cultivating future ICT talents. Therefore, the ICT literacy education for pre-service teachers should not only stay in cultivating their ability to simply obtain information, but also pay attention to cultivating their ability to critically discover, obtain and evaluate information and developing into a comprehensive ability to creatively create and use information technology and ethically engage in various information activities. China attaches great importance to the education of pre-service teachers' ICT literacy. In 2017, the Ministry of Education promulgated the "Implementation Measures for the Certification of Pre-service Teachers in General Institutes of Higher Education (Interim)" (JS [2017] No. 13), established a certification system for pre-service teachers, improved the education guarantee system for pre-service teachers, revitalized the education of pre-service teacher and solidified the foundation for cultivating high-quality teacher, so as to fully guarantee and constantly improve the talent cultivation quality of pre-service teachers. In 2018, the Ministry of Education promulgated the "Opinions on Implementing the Excellent Teacher Training Program 2.0" which proposed that "by 2035, the comprehensive quality, professional level and innovation ability of pre-service teacher will be significantly improved".

Pre-service teachers are practitioners and innovators of the future education cause. Only if the ICT literacy as needed in teacher's post is well mastered before serving as teacher can pre-service teacher well and quickly adapt to educational work. For pre-service teacher who want to be a good teacher in the future, ICT literacy has a key and leading influence. At the present stage in China, there is still a significant gap between pre-service teachers' ICT literacy level and the actual demand for them. Therefore, it is necessary to explore a long-term mechanism for pre-service teachers' ICT literacy education in order to improve pre-service teachers' ICT literacy and eventually cultivating them into high-quality professional and innovative teachers having life-long learning and development ability.

II. DEFINITION OF RELATED CONCEPTS

A. Pre-service Teacher

Pre-service teacher refer to a category of students who major in pedagogic specialty, has clear employment target in the future, namely to engage in teaching and management works in various levels and categories of school or educational institutions, and are reserved as future teachers [1].

B. Literacy

Literacy not only refers to knowledge and skills but also refers to the ability meet complex needs by using and mobilizing social psychosocial resources (including skills and attitudes) in specific context [2].

C. ICT Literacy

As defined by the Educational Testing Service (ETS) of USA, ICT literacy refers to the ability to use technology, communication tools and networks to acquire, manage, integrate, evaluate, and create information and play corresponding roles in the information society. In "The ICT Teaching Competency Standards for Pre-service Teachers" issued in China, pre-service teachers' ICT literacy is defined into three dimensions such as fundamental ICT literacy, ICT-based learning, and ICT-based teaching [3]. This definition is made on the basis of the characteristics of the group of pre-

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service teachers and takes into consideration the fully focusing on the combination of pre-service teacher's application ability (as a student) and transferability (as a teacher in the future). Regardless of the definition dimension, it can be seen that ICT literacy should cover ICT knowledge and capabilities, ICT awareness, and information ethics. In other words, ICT literacy not only includes relevant intelligence factors such as thinking ability, creativity, memory, and ICT knowledge and skill acquisition ability, but also includes relevant non-intelligence factors such as awareness, values, morality, legal and regulatory awareness.

D. Long-term Mechanism

Long-term mechanism refers to an institutional system that can guarantee the normal operation of a system and exert its intended functions for a long term. It is a supporting system that enables a system to function properly and perform its intended functions. Long-term mechanism is not always static and valid; it must be continuously developed, enriched and improved with the changes of conditions and time [4].

From the above, a research was made on the long-term mechanism for pre-service teachers' ICT literacy education, namely a mechanism adaptable to the change and development of intelligence factors and non-intelligence factors of pre-service teachers' ICT literacy with the time going, for the purpose of promoting long-term improvement of pre-service teachers' ICT literacy and meeting the demand of the information era.

III. CURRENT PROBLEMS EXISTING IN PRE-SERVICE TEACHERS' ICT LITERACY EDUCATION

A. Problems Existing in Relevant Researches

In recent years, with the rapid development of ICT, new demands have been constantly placed on talent cultivation. As the main base for talent cultivation, education also has increasing demand for informationization. China attaches great importance to the improvement of ICT literacy of relevant personnel in the education field. Relevant researches from all levels also become more and more extensive and in-depth. However in terms of future teacher (i.e., pre-service teacher), both the research object and content cannot adapt to the current pre-service teachers' ICT literacy education.

From the research object, most current researches are specific to in-service teachers and few of them pay attention to pre-service teachers, so that the standard and practices of in-service teachers are used in making research on pre-service teachers' ICT literacy. But compared with in-service teachers, pre-service teachers are quite different. At present, pre-service teachers in school are the generation born before and after 2000. They grow up along with the development of the information era and digital era and are aboriginal digital people in true sense. They have greater advantages in accepting, understanding and learning ICT than current in-service teachers. However compared with in-service teachers, pre-service teachers relatively lack practical experience, ICT integration and application skills, and ICT-based teaching and other ICT literacies. Thereby, pre-service teachers are different from in-service teachers in many aspects such as technical vision, teaching practice and learning demands. Hence in terms of improving pre-service teachers' ICT literacy, it is not appropriate to directly apply relevant literacy standards and measures for in-service teachers; and the inappropriate application of such standards and measures has also become a major problem hindering the improvement of pre-service teachers' ICT literacy.

From the research content, it is basically based on the macro strategy and is relatively one-sided, resulting in less operability; few researches involve in the ICT literacy to be possessed by pre-service teacher, and the ways to support pre-service teachers' current learning and future teaching and develop their transferability by improving their ICT literacy to form a lifelong learning literacy and construct their self-sustainable ICT literacy ecosystem.

B. Problems Existing in the Curriculum Setting of Normal Schools

Among on-campus courses, the ICT related courses are arranged not that rationally and not that highly connected with the education of each major and subject. For many years, the compulsory courses related to ICT as widely opened in normal schools are always mainly "Fundamentals of Computer Culture" and "Modern Education Technology", associated with some other elective courses. The course content is outdated, and there is a lack of connection between the various courses, lack of overall planning, and even lack of integration with the specific disciplines learned by students, so that the education has limited effect on improving pre-service teachers' ICT literacy.

C. Problems Existing in Teaching Mode

Currently, ICT courses in many normal schools are taught in traditional mode, namely the course is mainly taught by teacher and passively received by students; the teaching method is seriously lack of innovation and cannot adapt to the talent cultivation mode in the information society. The courses, which ought to provide a guide for information-based teaching of other disciplines on the basis of advanced ICT-based teaching method, fail to assume its responsibility.

D. Problems Existing in Pre-service Teachers Themselves

For a long time, pre-service teachers have always been unaccustomed to learn independently and actively in aspect of improving their ICT literacy and even unable to transform ICT into their ability to change their learning method, realize individual sustainable all-round development, adapt to future self-improvement and future teaching work. This is for reason that they have got used to the traditional knowledge-inculcation teaching mode and also because school mainly provides pre-service teachers with ICT literacy education by the only means of technical operation.

IV. Long-term Mechanism Strategy for Pre-service Teachers' ICT Literacy Education

A system method should be taken in order to study the long-term mechanism of pre-service teachers' ICT literacy education and further enable the mechanism to constantly develop, improve and enrich itself and play its intended function with the change of conditions and time. Taking pre-service teachers' ICT literacy education as a system, it is possible to study the main elements of the system, and on this basis, construct a system that can satisfy the whole, integrate the overall situation, unify the whole and the elements together dialectically, grasp the movement state and laws of the system and promote the development of the system. As a subsystem of education, pre-service teachers' ICT literacy education system is a complex system. It not only has many elements, but also has complicated relationships, movements and laws between the elements. This paper just makes a discussion from the perspective of the crucial human resources system; it is believed that the main elements of the system are school, teacher, pre-service teacher, and social enterprise. The elements will be discussed in turn in the following part.

A. School

School is the main base for carrying out pre-service teachers' ICT literacy education, the key to improving such students' ICT literacy, the key element of such literacy education system. It also has close relationship with other elements of the system and is a powerful support for promoting the development of other elements. School should strengthen management, adapt to the changing demands for pre-service teachers' ICT literacy over time, reform the talent cultivation mode and curriculum setting of pre-service teachers, as well as attach importance to enhancing fundamental ICT literacy, ICT-based learning and teaching, of talents and curriculum of normal students, and positively undertake the work to construct a sustainable lifelong learning ecosystem for pre-service teachers' ICT literacy.

As a key factor in improving pre-service teachers' ICT literacy, course teaching is the focus of school affairs. In aspect of course teaching, the TPACK (Technical Pedagogical and Content Knowledge)[5] proposed by American scholars Koehler and Mishra organically gets the interaction between technology, educational law and subject knowledge integrated, and provides a new theoretical basis for the cultivation of pre-service teachers' ICT literacy in the information era. The framework of this theory consists of three core elements such as subject content knowledge (CK), pedagogical knowledge (PK) and technical knowledge (TK), and four composite elements such as the pedagogical content knowledge (PCK) integrated pedagogy with subject, the technical pedagogical knowledge (TPK) integrated technology with pedagogy, the technical content knowledge (TCK) integrated technology with the subject, and the technical pedagogical content knowledge (TPACK) integrated technology with subject content and pedagogy. This theoretical framework covers all the curriculum systems of pre-service teachers' ICT literacy education and provides a theoretical reference and practical basis for the construction and improvement of the literacy knowledge system.

School can formulate a scientific education curriculum system for cultivating pre-service teachers' ICT literacy meeting the demand for development of the times with reference to this theoretical framework and in combination with its actual conditions.

As school plays an important role in the whole system, only if it interacts with other elements can it be available to solve the research, curriculum, teaching, student and other aspects of problems existing in pre-service teachers' ICT literacy education. According to the above questions, school should flexibly adjust ICT related courses, and keep pace with the times in terms of content setting, teaching methods, and learning methods. At the same time, school should keep pace with the times to provide training and practice for in-service teachers and pre-service teacher and provide a good ICT literacy improvement environment for pre-service teacher. School should also pay attention to creating opportunities for pre-service teachers to practice and do internship and improve their ICT literacy in specific practices. In addition, it is also needed to strengthen cooperation with enterprises, and use the advanced software and hardware resources and technology of enterprises to promote the improvement of pre-service teachers' ICT literacy.

B. Teacher

In the pre-service teachers' ICT literacy education system, teacher has dual tasks: teaching and demonstration. In terms of teaching, the same as any other knowledge, the improvement of ICT literacy depends on teacher's teaching. As for demonstration, according to social learning theory [6], there are two main ways of human's behavior acquisition: direct acquiring by individual's personal experience, and indirect acquiring by observing demonstrator's action (namely learning from observation). In actual learning, learning from observation is often more common. Pre-service teachers' ICT literacy level is mainly related to teacher's demonstration. Especially for ICT-based teaching literacy of pre-service teacher, pre-service teachers are in the pre-service stage of teacher profession and have limited opportunities to obtain direct teaching experience and skills by practical teaching; but if teacher can show high-level, innovative and normalized ICT literacy in daily teaching and life, pre-service teachers may be influenced in a subtle way by observing teacher's teaching action in daily learning process. This influence will be in-rooted. Therefore, teacher should pay attention to their demonstration role in student training in their daily teaching and life. Just as emphasized in the "Thirteenth Five-year Plan for Education Informationization" promulgated by the Ministry of Education in 2016, "Teachers should be encouraged to use ICT to create new teaching mode and promote the formation of a new normal of ICT-based teaching in classroom use, regular use and universal use". Teacher should actively promote the growth of students by playing their demonstration function.

C. Pre-service Teacher

Pre-service teacher has two roles: student and future teacher. ICT literacy should be improved from the two roles; in terms of students, ICT literacy is reflected in the ability to use ICT to support their learning and further promote the development and improvement of their ability, promote the transformation of their mode of learning and eventually realize individual's all-round development and lifelong development. Therefore, pre-service teachers' ICT literacy is not only reflected in technical operation and ICT-based learning, but also reflected in that it is a powerful supporting point for changing their mode of learning so as to promote improving their abilities of independent learning, innovation, communication, cooperation, solving problems, making decisions and the awareness of responsibility as demanded in the information era.

In terms of future teachers, it is needed to improve their ICT-based teaching literacy. This literacy is a necessary skill for pre-service teacher to engage in teaching in the future and includes ICT-based teaching resource design and production skills, ICT-based teaching skills, ICT-based learning mode transformation skills, ICT-based evaluation skills and so on.

Whether as a student or future teacher, transferability and self-development ability are crucial. The speed of development of ICT and updating of knowledge and technology has far exceeded people's learning speed; the knowledge learned during the school time will be quickly updated. Therefore, in the process of improving pre-service teachers' ICT literacy, it is especially necessary to pay attention to cultivating their self-learning, independent development, and knowledge transfer abilities and enhancing the ability to get what they have learned transferred into future teaching and life practices.

D. Social Enterprise

The said social enterprise mainly refers to information technology and service provider and educational information technology and service provider. As technology presents in exponential development status in ICT field, technology provider and educational information technology service provider in educational information technology field, except professional ICT teams in school, all play a role of promoting the practice and application of ICT in education field and promoting informationization development of learning; and in this process, professional ICT teams in school do not have the natural leading advantage due to the pioneering characteristics of technology. Therefore, it can be said that related social enterprises play an important role in promoting the informationization of learning. For example, seewo related software and hardware resources as widely applied in all levels of schools has played a significant role in transforming the modes of teacher's teaching and student's learning and provides great convenience for the improvement of pre-service teacher's ICT literacy. Hence, school should strengthen cooperation with related enterprises and extensively carry out school-enterprise cooperative and collaborative education, to jointly improve pre-service teachers' ICT literacy and contribute to informationization development of education in China.

V. CONCLUSION

In short, the current education on pre-service teachers' ICT literacy has been changed from compensating the "information gap" to compensating the "literacy gap". That is to say, the said education has been changed from the information gap as caused by the unequal allocation of ICT-based teaching equipment and educational resources to the "quality gap" as caused by the differences in people's ICT knowledge and ability, awareness and morality. Therefore, the key to long-term development of pre-service teachers' ICT literacy education is to carry out the education in a way adaptable to the development demand of the times.

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